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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte TAE-SUNG KIM and KYUNG-JIN YOO

Appeal 2009-002505
Application 10/767,281
Technology Center 2800

Decided: September 22, 2009

Before MARC S. HOFF, CARLA M. KRIVAK,
and THOMAS S. HAHN, *Administrative Patent Judges*.

HAHN, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants invoke our review under 35 U.S.C. § 134(a) from the Examiner's rejections of claims 1, 2, 4-9, 11-15, 17-19, and 21-24. We have jurisdiction under 35 U.S.C. § 6(b). An oral hearing was held on August 6, 2009. We affirm.

STATEMENT OF THE CASE

Appellants claim an invention for thin film transistor (TFT) source and drain electrodes, a flat panel display having such TFTs, and a process for making a flat panel display having such TFTs. The claimed source and drain electrodes have a pair of titanium layers positioned about a pair of diffusion prevention layers that are positioned about an aluminum alloy layer. Besides aluminum, the aluminum alloy includes at least one element selected from a group consisting of silicon, copper, neodymium, platinum, and nickel.¹ Claims 1 and 21 are illustrative:

1. A thin film transistor, comprising a source electrode, a drain electrode, a gate electrode and a semiconductor layer,

wherein one of the source electrode and drain electrode comprises an aluminum alloy layer disposed between a pair of titanium layers,

wherein a diffusion prevention layer is interposed between the aluminum alloy layer and each of the pair of titanium layers, and

wherein the aluminum alloy layer comprises at least one element selected from a group consisting of silicon, copper, neodymium, platinum and nickel.

21. A process for making a flat panel display, comprising:

forming a first plurality of thin film transistors formed on a surface of a substrate, the first plurality of thin film transistors comprising first source electrodes, first drain electrodes, first gate electrodes, and semiconductor layers;

¹ See generally Spec. ¶¶ [0042]-[0046]; Figs. 2 and 7-10.

electrically connecting a plurality of first conductive lines to the first source electrodes;

electrically connecting a plurality of second conductive lines to the first gate electrodes; and

forming a second plurality of thin film transistors, electrically connecting the first drain electrodes of the first plurality of thin film transistors to gate electrodes of the second plurality of thin film transistors, wherein one of the first source electrodes, the first drain electrodes, the plurality of first conductive lines, and the plurality of second conductive lines comprises an aluminum alloy layer and a titanium layer formed on both surfaces of the aluminum alloy layer, and interposing a diffusion prevention layer between the aluminum alloy layer and the titanium layers, and wherein the aluminum alloy layer comprises at least one element selected from a group consisting of silicon, copper, neodymium, platinum and nickel.

The Examiner relies on the following as evidence in support of the rejections:

Maeda US 5,278,099 Jan. 11, 1994

Ohtani US 6,271,543 B1 Aug. 7, 2001

Yamazaki US 2003/0222575 A1 Dec. 4, 2003

1. The Examiner rejected claims 1, 2, 4-7, 14, 15, and 17-19 under 35 U.S.C. § 103(a) as unpatentable over Ohtani and Maeda (Ans. 3-6).²
2. The Examiner rejected claims 8-13 and 21-24 under 35 U.S.C. § 103(a) as unpatentable over Ohtani, Maeda, and Yamazaki (Ans. 6-8).

² Although the Examiner includes claim 9 in the rejection statement (Ans. 3), we presume this is a typographical error based on the record. Claim 9 is dependent from independent claim 8, and claim 9 is included in the rejection statement for claim 8 (Ans. 6). The Examiner only addresses claim 9 with the rejection of claim 8 (Ans. 8), and, therefore, we address claim 9 with that rejection.

Rather than repeat the arguments of Appellants or of the Examiner, we refer to the Briefs and the Answer³ for their respective details. In this decision, we have considered only those arguments actually made by Appellants. Arguments that Appellants could have made but did not make have not been considered and are deemed to be waived. *See* 37 C.F.R. § 41.37(c)(1)(vii).

Appellants' Arguments

Appellants' arguments are collectively directed to all rejected claims being patentable, because Appellants assert that Ohtani and Maeda, whether taken singly or in combination, are deficient as to the claimed TFT source and drain electrodes having an aluminum alloy layer positioned between a pair of titanium layers with a diffusion prevention layer interposed between the aluminum alloy layer and each of the pair of titanium layers (App. Br. 12-14; Reply Br. 1-4). Additionally, Appellants selectively address dependent claim 18 by asserting that the claimed subject matter "does not appear to have been considered by the Examiner" (App. Br. 14).

Appellants conclude by asserting for independent claims 8 and 21 that the Examiner's citation of Yamazaki is improper because claims 8 and 21 are rejected "as obvious over the combination of Ohtani and Maeda" (App. Br. 15). Appellants' apparent argument is that the rejection of these claims is premised upon a combination of only Ohtani and Maeda, with Yamazaki exclusively being cited by the Examiner to support an associated contention.

³ We refer throughout this opinion to (1) the Second Substitute Appeal Brief filed Feb. 8, 2008, (2) the Examiner's Answer mailed May 5, 2008, and the Reply Brief filed June 16, 2008.

The record contradicts such an argument. Independent claims 8 and 21, along with dependent claims 9-13 and 22-24, stand rejected under § 103(a) over a combination of all three of Ohtani, Maeda, *and* Yamazaki (Ans. 6-8). The Examiner responds to Appellants' assertion by noting that Appellants are silent as to "reasons why the rejection is improper" (Ans. 12). We concur with the Examiner in that both Appellants' Appeal Brief and Reply Brief are silent as to reasons why the rejection is improper, and, therefore, we do not further consider Appellants' assertion that the rejection is improper. *See* 37 C.F.R. § 41.37(c)(1)(vii) ("Any arguments or authorities not included in the brief or reply brief . . . will be refused consideration by the Board . . .").

ISSUES

1. Have Appellants shown the Examiner erred in finding under § 103(a) that the combination of Ohtani and Maeda teaches or suggests (i) TFT source and drain electrodes having an aluminum alloy layer positioned between a pair of titanium layers with interposed diffusion prevention layers as recited in representative claim 1; and (ii) a silicon semiconductor layer forming a conductive channel between the source and drain electrodes when a voltage is applied to the gate electrode as recited in claim 18?⁴

2. Have Appellants shown the Examiner erred in finding under § 103(a) that the combination of Ohtani, Maeda, and Yamazaki teaches or

⁴ Appellants separately argue dependent claim 18, and collectively argue claims 1, 2, 4-7, 14, 15, 17, and 19 (App. Br. 12-14). We, accordingly, separately address dependent claim 18, and select independent claim 1 as representative of the other claims. *See* 37 C.F.R. § 41.37(c)(1)(vii).

suggests TFT source and drain electrodes having an aluminum alloy layer positioned between a pair of titanium layers with interposed diffusion prevention layers as recited in representative claim 21?⁵

FINDINGS OF FACT

A preponderance of the evidence supports the following Findings of Fact (FF):

Present Application

1. Appellants' Specification discloses that heat treating a TFT having the following source and drain electrode structure will avoid electrode material forming hillocks or reacting with adjacent semiconductor material, and will also prevent increases in electrode electrical resistance. The disclosed electrode structure utilizes an aluminum alloy layer with one element selected from silicon, copper, neodymium, platinum, and nickel. The aluminum alloy layer is positioned between titanium layers with a pair of diffusion prevention layers - such as titanium nitride (TiN) - positioned between the aluminum alloy layer and the titanium layers (Spec. ¶¶ [0012]-[0014]).

Ohtani

2. Ohtani discloses a layered active matrix display with sandwiched multiple TFTs, and also discloses a method for manufacturing such an active matrix display with TFTs (Title; col. 1, ll. 8-11; col. 2, ll. 10-18).

⁵ Appellants collectively argue independent claims 8 and 21 from rejected claims 8-13 and 21-24 (App. Br. 15). We, accordingly, select independent claim 21 as representative of this group. See 37 C.F.R. § 41.37(c)(1)(vii).

3. Ohtani's TFT manufacturing process provides that both a TFT source line 206 and drain line 207 have a sandwiched "three-layer laminated structure of titanium/aluminum/titanium" with a silicon semiconductor channel formed between the source and drain (col. 6, ll. 51-58, 63-66; col. 7, ll. 10-12; Fig. 2D).

4. Ohtani further discloses forming and patterning a TFT gate electrode from an aluminum film or a material mainly containing aluminum, e.g., an aluminum film containing scandium 2 wt % (col. 6, ll. 59-62).

Maeda

5. Maeda discloses a manufacturing method for a semiconductor device with aluminum electrode wiring structures that are intended to prevent heat treatment induced diffusion with resulting reaction of the aluminum with adjacent semiconductor material, and increased electrode contact resistance (col. 1, ll. 14-64).

6. The Maeda discloses a source, drain, and gate electrode structure having a first layer of titanium (Ti), a second layer of TiN formed on the Ti layer, and a third layer having aluminum formed on the TiN layer (col. 2, ll. 10-21; col. 3, ll. 44-46).

7. Maeda further discloses that the described source, drain, and gate electrode structure "is not limited to" having a pure aluminum layer 36 adjacent the TiN layer. Maeda discloses that the aluminum "layer 36 can be replaced by one alloy selected from Al-Si, Al-Ti-Si, Al-Zr-Si, Al-Ti, and Al-Zr" (col. 4, ll. 22-25).

Yamazaki

8. Yamazaki discloses an electric field controlled light emitting apparatus that uses TFTs (¶¶ [0002], [0014]).

9. Yamazaki's light emitting apparatus includes a switching TFT 656 and a driving TFT 607 with a drain electrode of the switching TFT 656 connected to the gate electrode of the driving TFT 607 (¶ [0175]).

PRINCIPLES OF LAW

An Examiner, in rejecting claims under 35 U.S.C. § 103, must establish a factual basis to support a legal conclusion of obviousness. *See In re Fine*, 837 F.2d 1071, 1073 (Fed. Cir. 1988). The required factual determinations are set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966) (explaining that 35 U.S.C. § 103 leads to three factual inquiries: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims at issue; and (3) the level of ordinary skill in the art). Furthermore, the Supreme Court has explained that an obviousness rejection must be based on:

“‘some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness’.... [H]owever, the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.”

KSR Int'l v. Teleflex, Inc., 550 U.S. 398, 418 (2007) (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006).

ANALYSIS

Obviousness Rejection Based on Ohtani and Maeda

Claims 1, 2, 4-7, 14, 15, 17, and 19

Appellants acknowledge, and we concur, that Ohtani teaches a titanium/aluminum/titanium TFT source and drain electrode structure (App. Br. 12; FF 3). Appellants then assert that Ohtani “teaches away” from using an aluminum alloy for source and drain electrodes, because the reference indicates that either an aluminum or an aluminum alloy can be used for gate electrode wiring, while being silent as to whether an aluminum alloy could be used for source and drain electrodes (App. Br. 12). The Examiner responds that if aluminum alloys are not to be used, “Ohtani would have specifically stated that an aluminum alloy cannot be used for the source line and drain electrode” (Ans. 9). The Examiner’s response, we conclude, is reasonable and rational, because we indeed found no teaching or suggestion in Ohtani excluding the use of any aluminum alloy for source or drain electrode structures. *See In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (“[M]ere disclosure of more than one alternative does not constitute a teaching away . . . because such disclosure does not criticize, discredit, or otherwise discourage [the proposed] solution . . .”). Appellants’ contention lacks evidence to support their assertion that Ohtani teaches away.

Significantly, the Examiner indicates agreement that “Ohtani does not specifically disclose the [use of an] aluminum alloy for the source and drain electrodes, however Maeda cures the deficiencies of Ohtani by teaching an aluminum alloy layer for an electrode” (Ans. 10). Indeed, we find that Maeda discloses that either aluminum or an aluminum alloy, such as Al-Si,

can be used for source, drain, or gate electrodes (FF 7).⁶ Further, the Examiner finds, as we also find, that Maeda discloses “specific teachings and benefits for using [a] TiN layer and [an] Al alloy layer . . .” (Ans. 10; FF 5-7). As the Examiner indicates, the disclosed Maeda TiN layer is formed between the Ti and aluminum alloy layers (Ans. 4; FF 6, 7).⁷

Appellants contend, without citing authority, that “it is settled patent law that merely because one can modify a subject device in a reference to produce a device which purportedly meets the recited limitations of a rejected claim does not mean that it would be obvious to do so” (App. Br. 14) (emphases deleted). Concerning such patent law, the Supreme Court recently explained that an obviousness rejection must be based on “some articulated reasoning with some rational underpinning . . .” *KSR*, 550 U.S. at 418.

Based on the record, we conclude that the Examiner has articulated reasoning with rationale for the modification of Ohtani with Maeda teachings to support a *prima facie* obviousness rejection. For example, the Examiner states that “Maeda recites specific teachings and benefits for using the TiN layer and the Al alloy layer and therefore cures the deficiencies of Ohtani” (Ans. 10). We find that Ohtani discloses a layered active matrix display with sandwiched multiple TFTs (FF 2; *see also* Ans. 3, 4). Ohtani-

⁶ Representative claim 1 recites that “the aluminum alloy layer comprises at least one element selected from a group consisting of silicon . . .”

⁷ The source and drain electrode structure covered by representative claim 1 includes a diffusion prevention layer. Appellants’ application discloses that a layer of TiN is a diffusion prevention layer (FF 1). Accordingly, we conclude that representative claim 1 reads on a TiN layer.

discloses TFTs have titanium/aluminum/titanium layered source and drain electrode structures (Ans. 3, 4; FF 3).⁸

Turning to Maeda, we find that it discloses a manufacturing method for semiconductor devices having source, drain, and gate aluminum electrode structures that are intended to prevent heat treatment induced diffusion with resulting reaction of the aluminum with adjacent semiconductor material, and increased electrode contact resistance (FF 5; *see also* Ans. 4). Maeda further discloses that this electrode structure includes a TiN layer formed between Ti and aluminum alloy layers, where the aluminum alloy layer can be Al-Si (Ans. 4; FF 6).

In order to modify a reference under § 103, the Supreme Court directs that: “if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *KSR*, 550 U. S. at 417. Maeda discloses an improved semiconductor device source and drain electrode structure to avert identified deleterious heat treatment effects (FF 5, 6). Appellants have not refuted this record with submitted evidence or persuasive arguments that an ordinarily skilled artisan would be unable to recognize Maeda-identified problems and taught improvements, or that Maeda’s electrode structure improvement is beyond such an artisan’s skill to utilize. The Supreme Court further directs that: “[u]nder the correct analysis, any . . . problem known in the field of endeavor at the time of

⁸ We do not address whether Ohtani in addition to teaching use of aluminum alloys for gate electrodes also teaches or suggests use of aluminum alloys for source and drain electrodes.

invention . . . can provide a reason for combining the elements in the manner claimed.” *KSR*, 550 U.S. at 420. Maeda explicitly discloses both knowledge of heat treatment induced electrode problems and an electrode structure to avert these effects (FF 5-7).

On this record, we conclude the Examiner has provided adequate reasoning with rationale for a § 103 combination of Ohtani and Maeda. We further conclude that Maeda’s teachings concerning heat treatment induced problems and a solution provide adequate reasoning with rationale for modification of Ohtani with the Maeda-disclosed electrode structure.

In conclusion, Appellants collectively assert for the grouped claims that “[a]s to the recited specific weight percentage of the element in the alloy and the thickness of the titanium nitride layer or the percentage of nitrogen within the desired range, the Examiner has made an unsupported statement that these recited features would be obvious to one skilled in the art” (App. Br. 14). Appellants’ assertion, which is unspecified as to any claim(s) or recited limitation(s), is apparently directed to all of dependent claims 2, 4-7, 14, 15, and 17-19. Despite the assertion, we conclude from the record that each of these claims is separately addressed by the Examiner with adequate reasoning for rejection (Ans. 4, 5). Accordingly, Appellants have simply not persuasively rebutted the Examiner’s positions, which we find to be reasonable.

For the foregoing reasons, Appellants have not persuaded us of error in the rejection of representative claim 1. Therefore, we will sustain the Examiner’s rejection of that claim, and claims 2, 4-7, 14, 15, 17, and 19 that fall with claim 1.

Claim 18

Appellants' entire argument is that "disregarding the recited process limitation, claim 18 recites that the semiconductor of [sic] layer forming a conductive channel between the source electrode and drain electrode upon application of a voltage to the gate electrode does not appear to have been considered by the Examiner" (App. Br. 14). In contradistinction to this argument, the Examiner provides reasoning with rationale for rejecting both claims 17 and 18 (Ans. 5, 6). Further, the Examiner addresses Appellants' assertions (Ans. 11) and concludes with the statement that Appellants have "not provide[d] reasons why the limitations of claim 18 are patentably distinguishable over the prior art." For example, the Examiner indicates, and we concur, that: "Ohtani discloses (col. 6, lines 63-67) that a channel is formed between the source and drain of the device. The semiconductor is also primarily made of silicon (col. 6, lines 51-58) and contains the conductive channel." (Ans. 6; FF 3).

The Examiner's position, we conclude, is reasonable, and Appellants have not provided evidence or any argument to rebut that position. Accordingly, we will sustain the Examiner's rejection of claim 18.

Obviousness Rejection Based on Ohtani, Maeda, and Yamazaki

Claims 8-13 and 21-24

Regarding representative claim 21, Appellants paraphrase the Examiner's findings concerning Yamazaki but do not point out errors in the Examiner's reasoning to persuasively rebut the Examiner's *prima facie* obviousness case.

For the foregoing reasons set out *supra* directed to Ohtani and Maeda, Appellants have not persuaded us of error in the rejection of representative

claim 21. Therefore, we will sustain the Examiner's rejection of that claim, and also claims 8-13 and 22-24 that fall with claim 21.

CONCLUSION

Appellants have not shown that the Examiner erred in finding under § 103(a) that the combination of Ohtani and Maeda teaches or suggests (i) TFT source and drain electrodes having an aluminum alloy layer positioned between a pair of titanium layers with interposed diffusion prevention layers as recited in representative claim 1; and (ii) a silicon semiconductor layer forming a conductive channel between the source and drain electrodes when a voltage is applied to the gate electrode as recited in claim 18.

Appellants also have not shown that the Examiner erred in finding under § 103(a) that the combination of Ohtani, Maeda, and Yamazaki teaches or suggests limitations of representative claim 21.

ORDER

The decision of the Examiner rejecting claims 1, 2, 4-9, 11-15, 17-19, and 21-24 under 35 U.S.C. § 103(a) is affirmed.

Appeal 2009-002505
Application 10/767,281

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

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